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TECHNICAL NOTE No: AERO. 1856.

# ROYAL AIRCRAFT ESTABLISHMENT

Farnborough, Hants.

AT! No. **9518** 352324

## MEASUREMENTS OF THE TEMPERATURE DISTRIBUTION IN AND AROUND A HOT JET IMPINGING ON A FLAT PLATE

~~REDACTED~~

by

A. S. WORRALL, B.Sc.

and

E. F. LAWLOR

~~REDACTED~~



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ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH

Measurements of the Temperature Distribution  
in and around a Hot Jet Impinging on a Flat Plate

- by -

A.S. Worrall, B.Sc.,  
E.F. Lawlor.

Summary

Measurements have been made of the temperature distribution in and around a hot jet impinging on a flat plate in still air. A range of jet positions was tested in order to cover the possible layouts of future jet aircraft.

1 Introduction

Tests were required to determine the maximum temperatures likely to occur on the decks of aircraft carriers due to jet aircraft; also to determine the possible positions of tailplanes, tail-wheels, etc.

2 Tests

The apparatus used was as in Fig. 1. The temperature distribution on the non-conducting flat plate was measured by means of thermocouples inset into the surface in the positions indicated. The temperatures around the jet were measured by means of a traversing thermocouple in the usual way.

The jet was kept in a horizontal position, the inclination of the plate to the horizontal, and the vertical distance from the surface of the plate to the centre of the jet being changed as shown in the Figures.

Throughout the tests the jet temperature was kept constant at 200°C (room temperature 20°C) and the jet velocity was 600 f.p.s. The jet diameter,  $d$ , was 1 inch.

3 Results

The results are given in the form of contours of constant Temperature Coefficient, the Temperature Coefficient,  $\theta$ , being defined by:

$$\theta = \frac{T - T_0}{T_1 - T_0}$$

-/-



where

$T$  is the temperature at the point being considered.  
 $T_1$  is the jet stagnation temperature.  
 $T_0$  is the room temperature.

The final results for the surface temperatures are given in Figs. 2 - 6. The original data are in error because insufficient time was allowed for steady conditions to be attained. Some supplementary tests were made to determine the correction but a proportion of the measurements has been rejected. The programme of tests and the results which are included as being reliable are shown in Table I.

The results of the traverse tests are given in Figs. 7 - 10. These results fit in well with the surface temperature measurements.

Attached:-

Table I.  
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Table I

Range of Tests.

$\alpha \backslash H/d$	2	4	6	8	10
5°		Fig.3(a)			
10°	Fig.2(a)	Figs.3(b), 7, 8, 9, 10			
15°		Fig.3(c)			
20°	Fig.2(b)		Fig.4(a)		
25°		Fig.3(d)		Fig.5(b)	Fig.6(b)
30°	Fig.2(c)		Fig.4(b)	Fig.5(c)	Fig.6(c)

$\alpha$  = Jet incidence

$d$  = Jet diameter

$H$  = Height of centre of nozzle above plate.

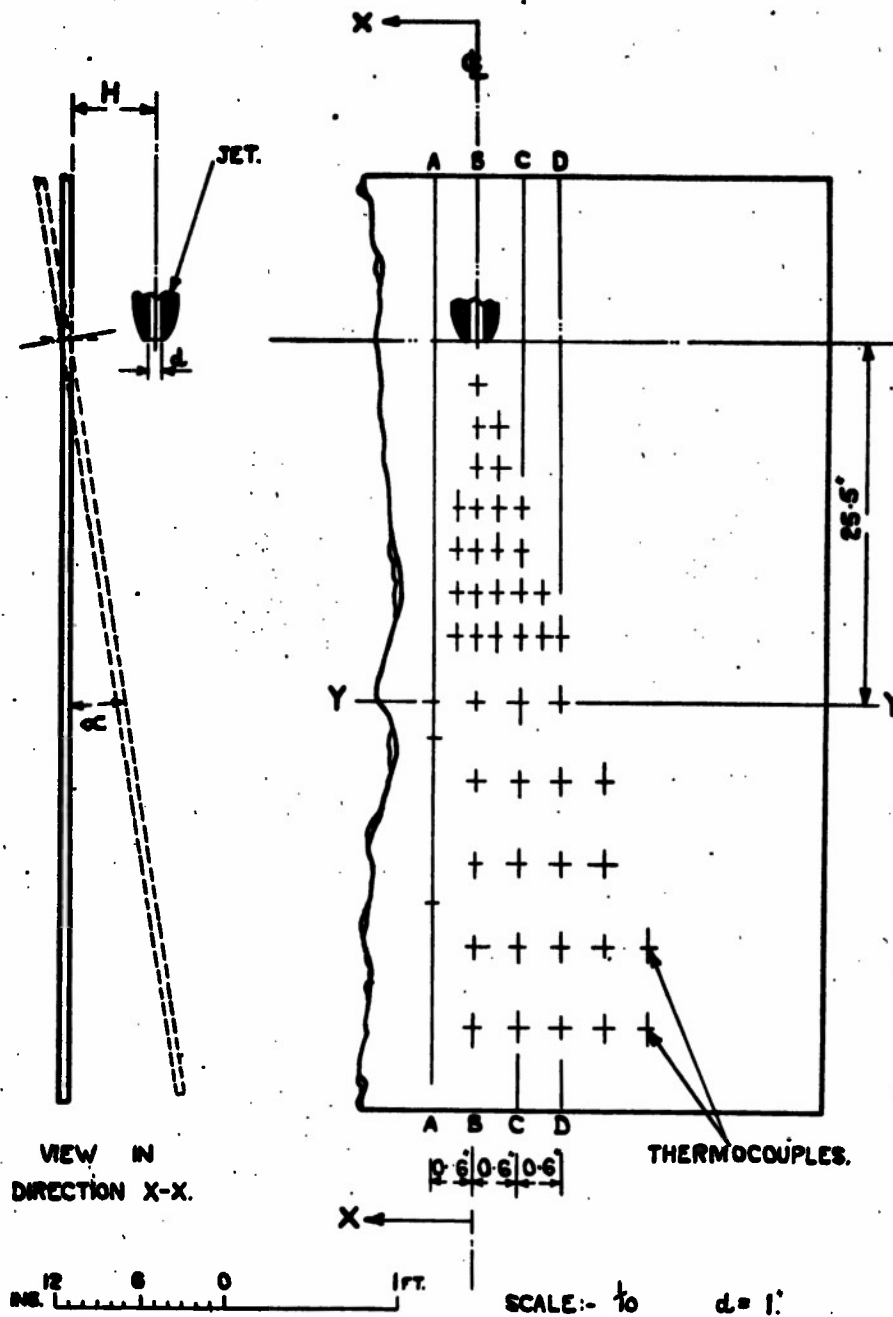


FIG. I. GA. SHOWING ARRANGEMENT OF SURFACE THERMOCOUPLES.

FIG. 2(a),(b).

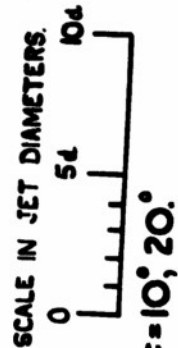
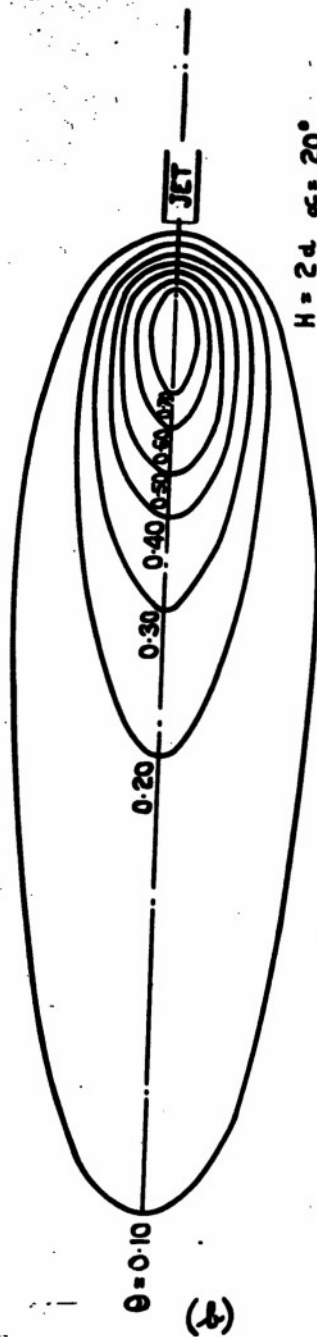
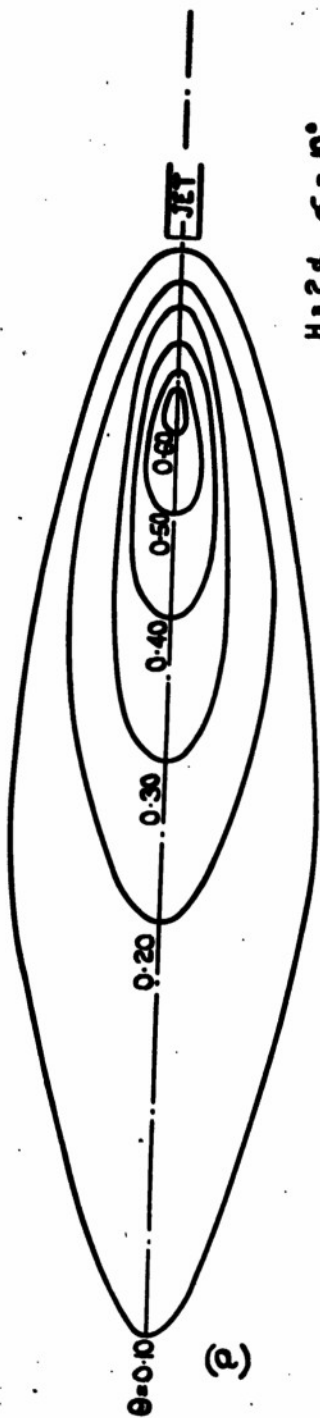


FIG. 2(a),(b). TEMPERATURE DISTRIBUTION

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FIG. 2(c).

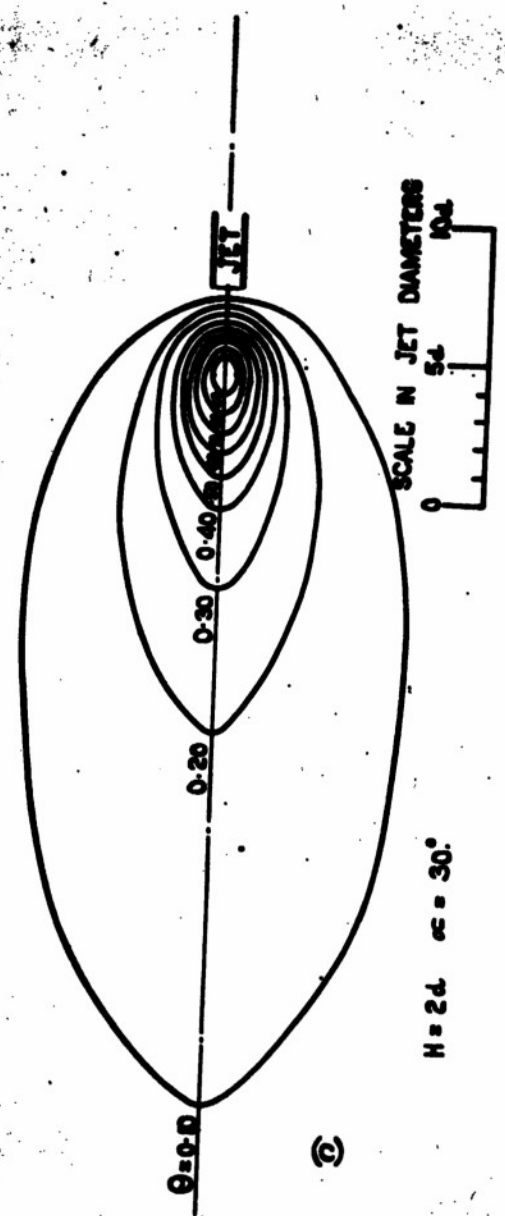
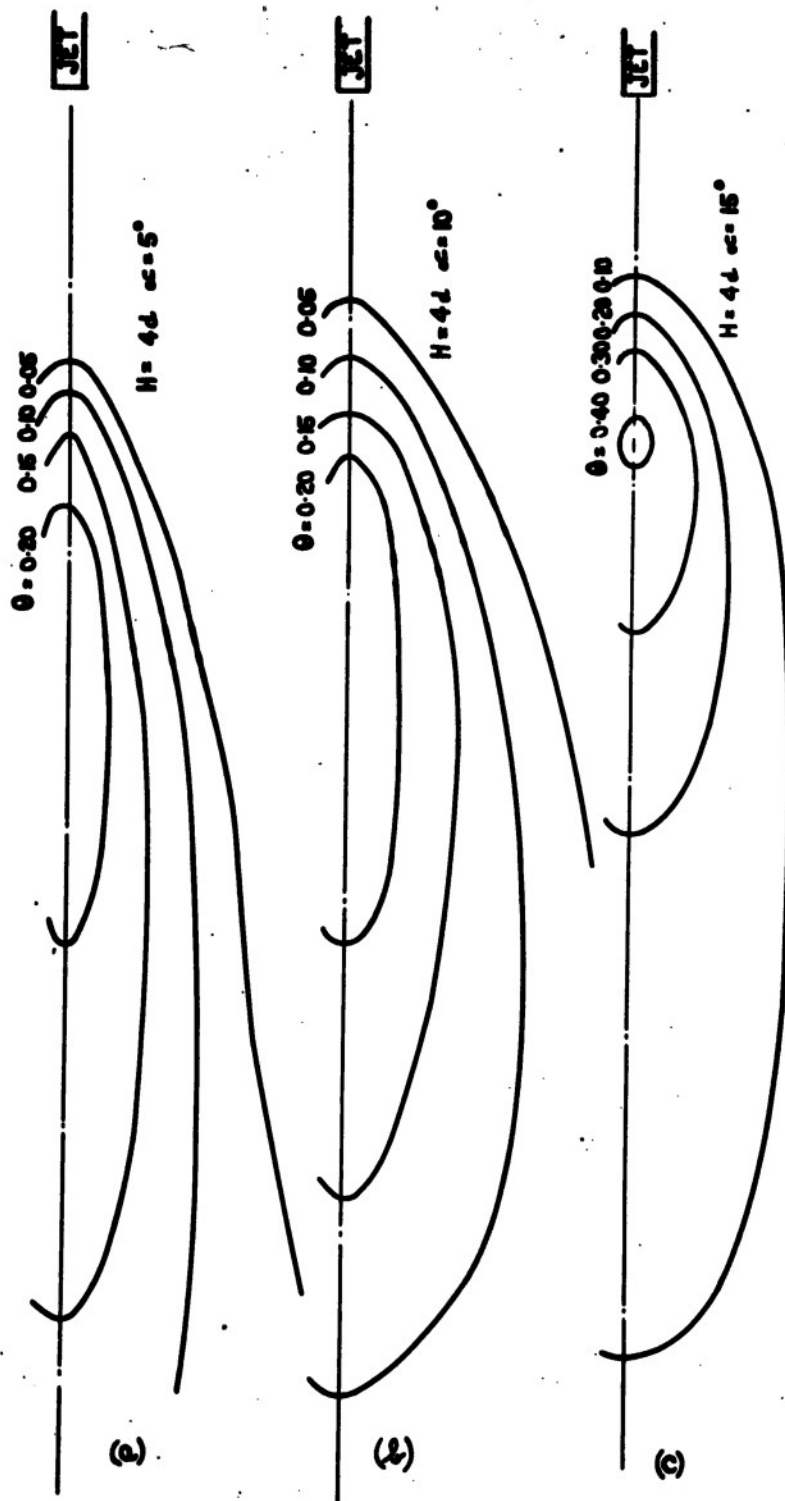


FIG. 2(c). TEMPERATURE DISTRIBUTION  $H = 2d$   $\alpha = 30^\circ$ .

FIG. 3(a),(b),(c).



SCALE IN JET DIAMETERS.  
 0 5d 10d

FIG. 3(a),(b),(c). TEMPERATURE DISTRIBUTION  $H = 4d$   $\alpha = 5^\circ, 10^\circ, 15^\circ$ .

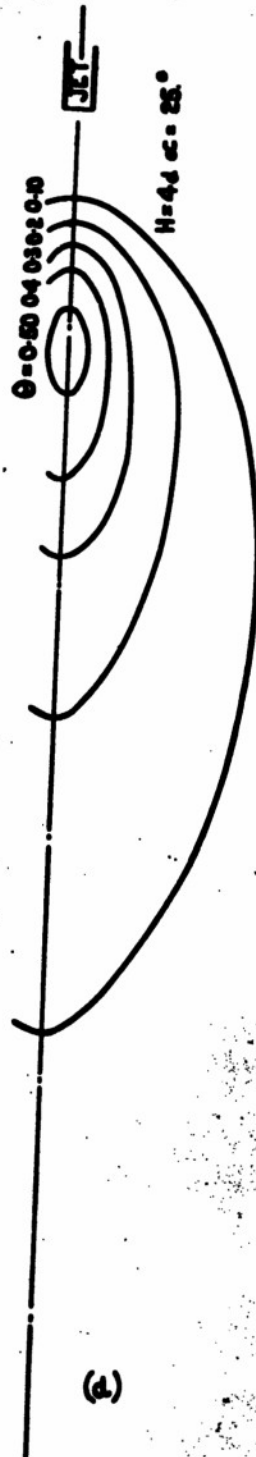
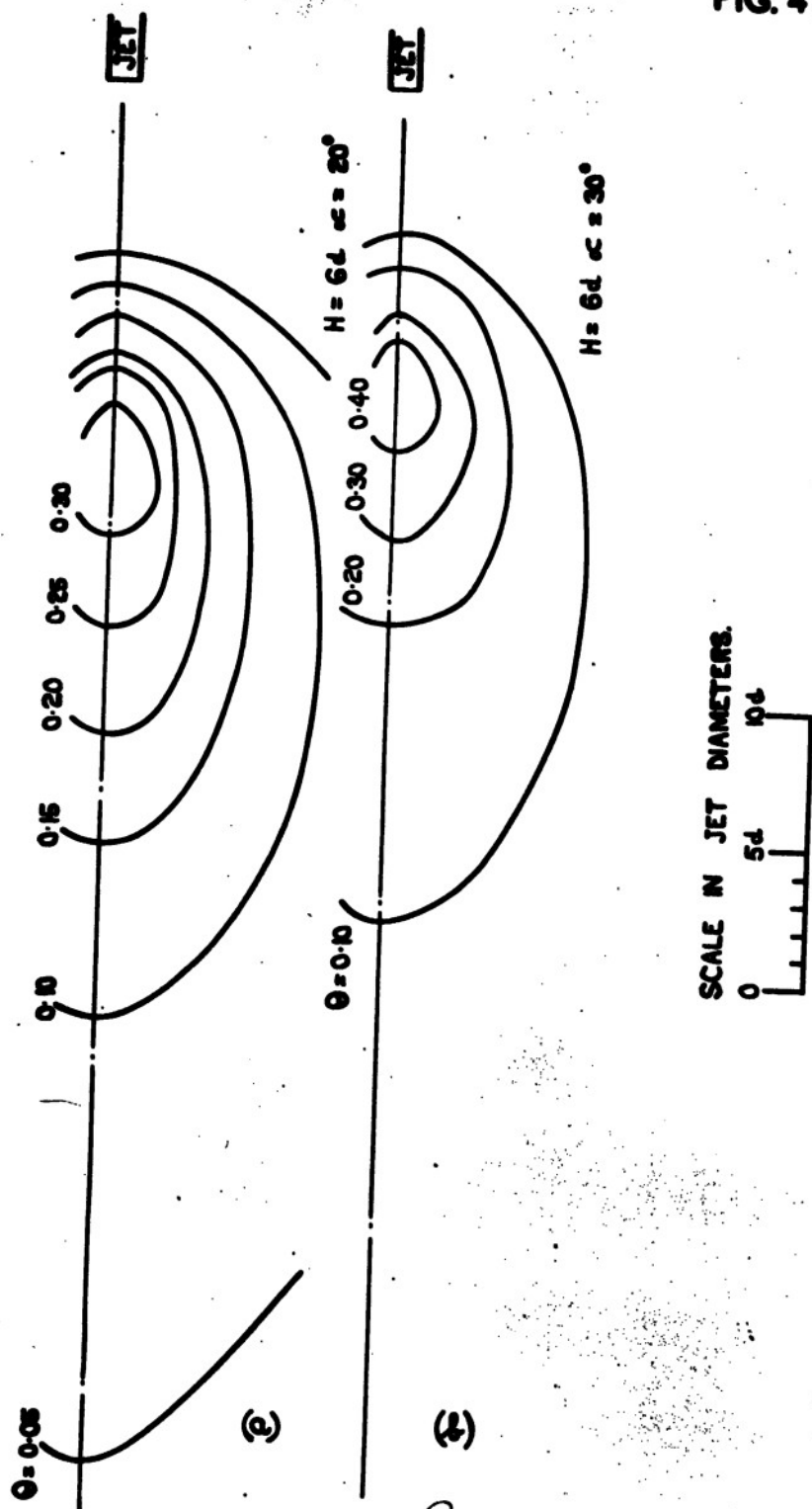


FIG. 3(d) TEMPERATURE DISTRIBUTION  $H = 4d$   $\alpha = 25^\circ$

FIG. 4(a)(b).

FIG. 4(a)(b). TEMPERATURE DISTRIBUTION  $H = 6d$   $\alpha = 20^\circ, 30^\circ$ .



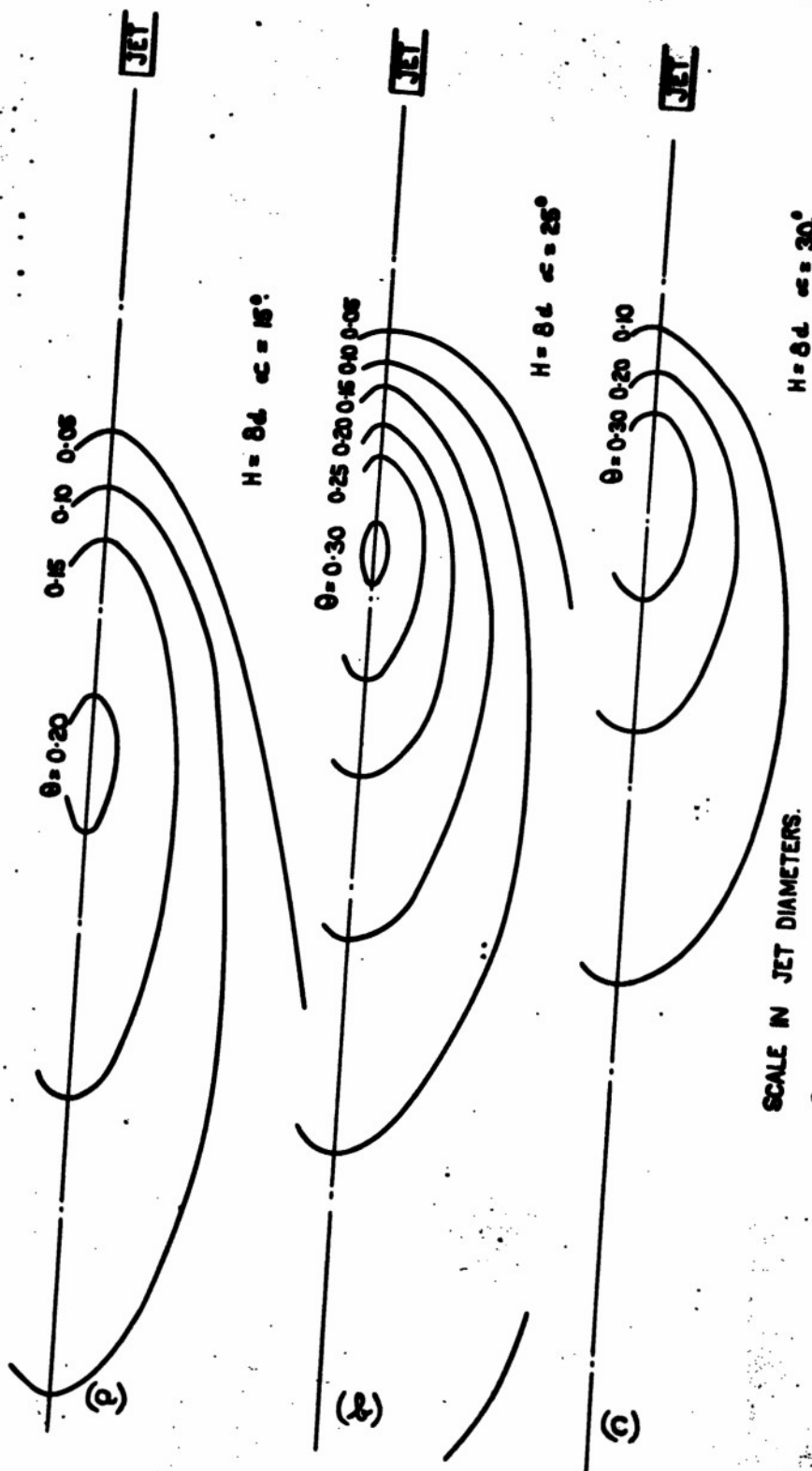


FIG. 5(a),(b),(c) TEMPERATURE DISTRIBUTION  $H = 8d$   $\alpha = 15^\circ, 25^\circ, 30^\circ$ .

FIG. 6(a),(b),(c).

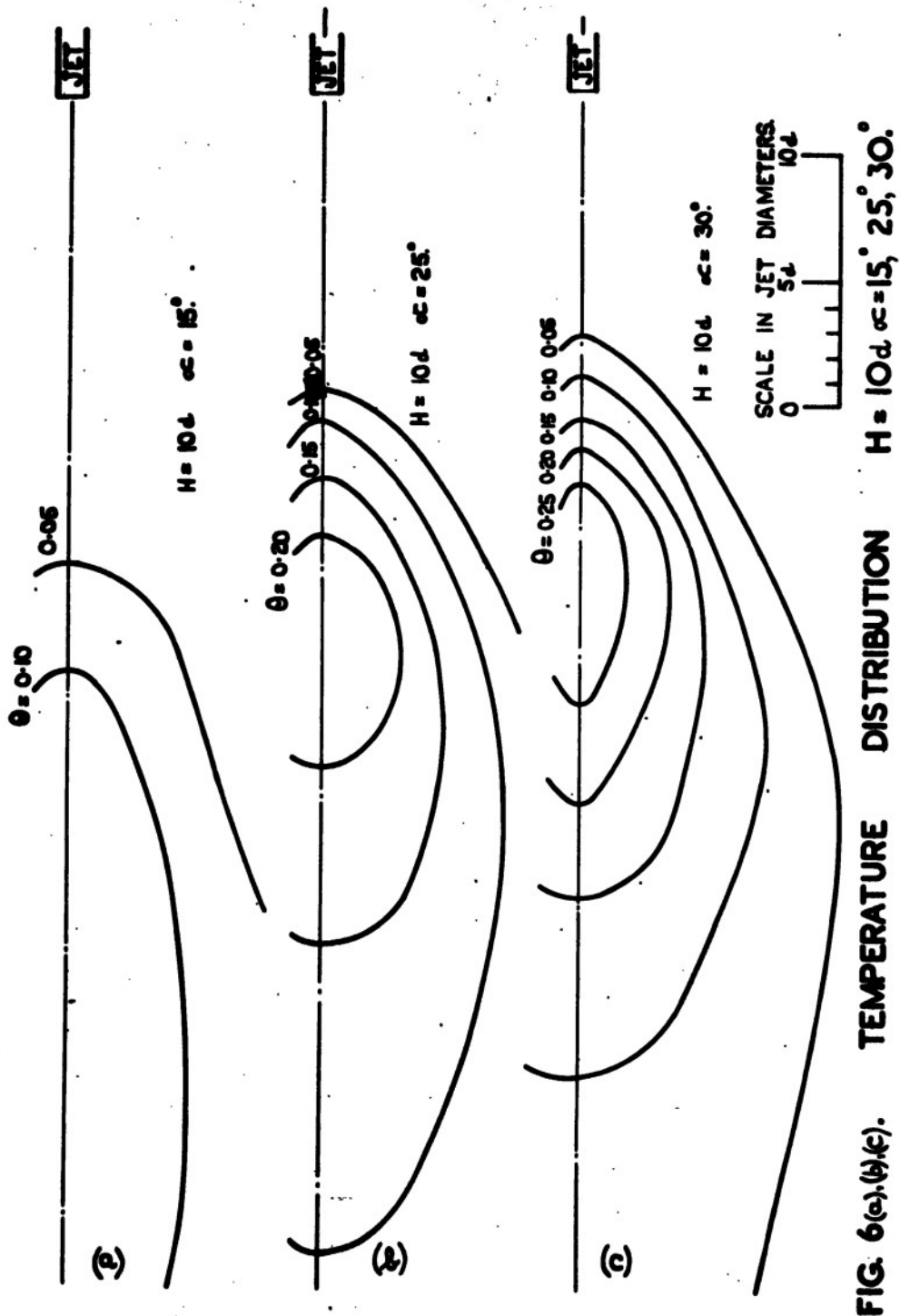


FIG. 6(a),(b),(c). TEMPERATURE DISTRIBUTION  $H = 10d$   $\alpha = 15^\circ, 25^\circ, 30^\circ$ .

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FIG. 7

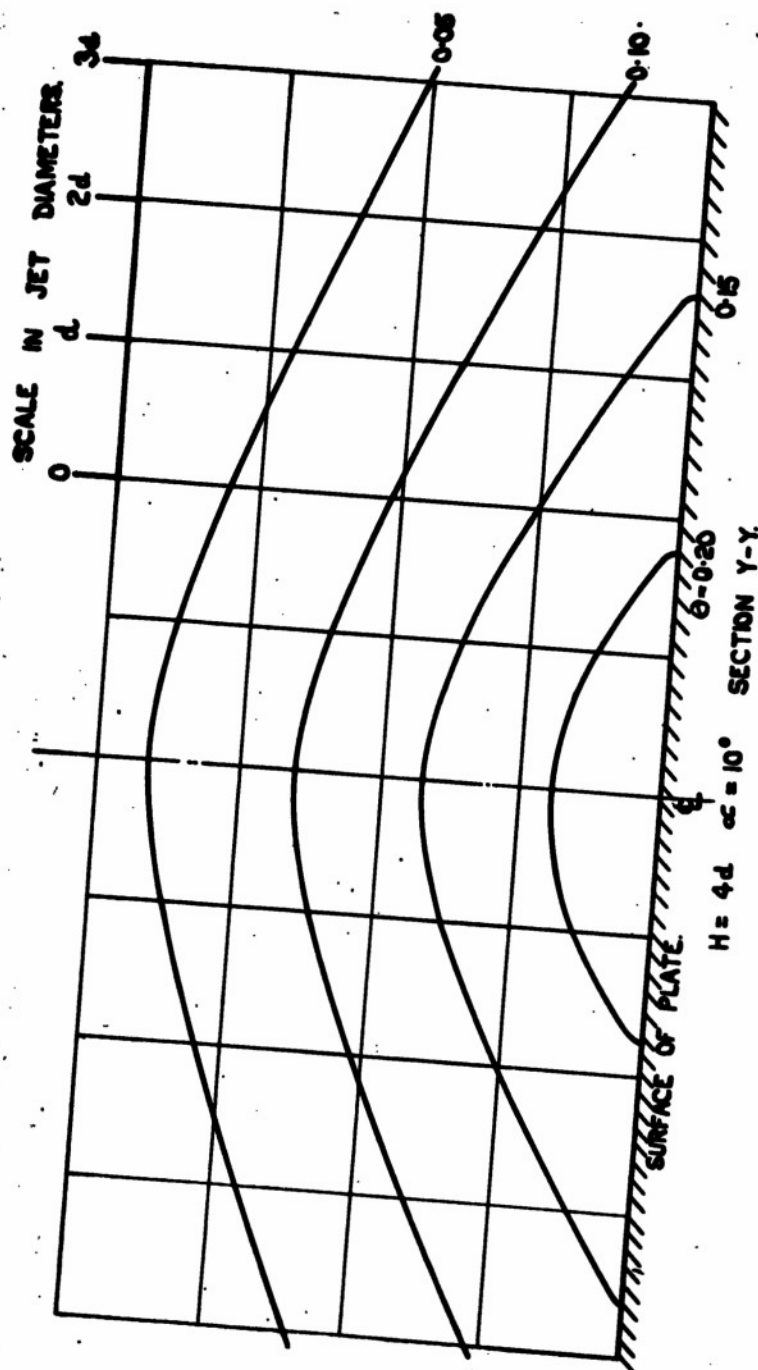
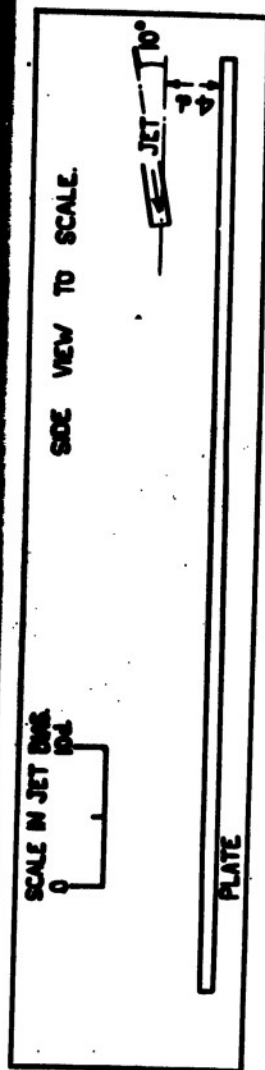


FIG. 7. TEMPERATURE DISTRIBUTION IN VERTICAL PLANE THRO' Y-Y.

FIG. 8.



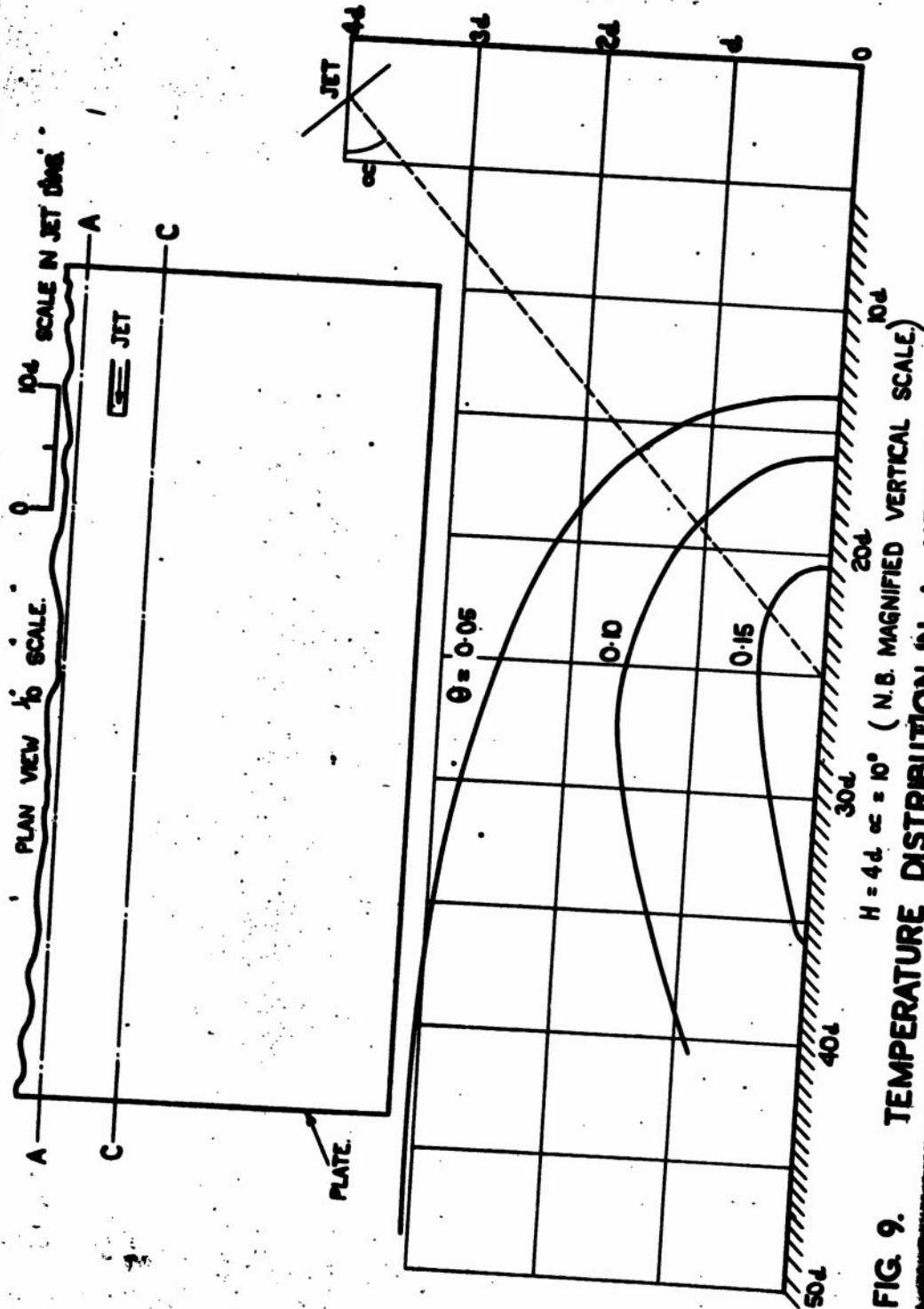


FIG. 9. TEMPERATURE DISTRIBUTION IN A VERTICAL PLANE THRO' AA & CC.

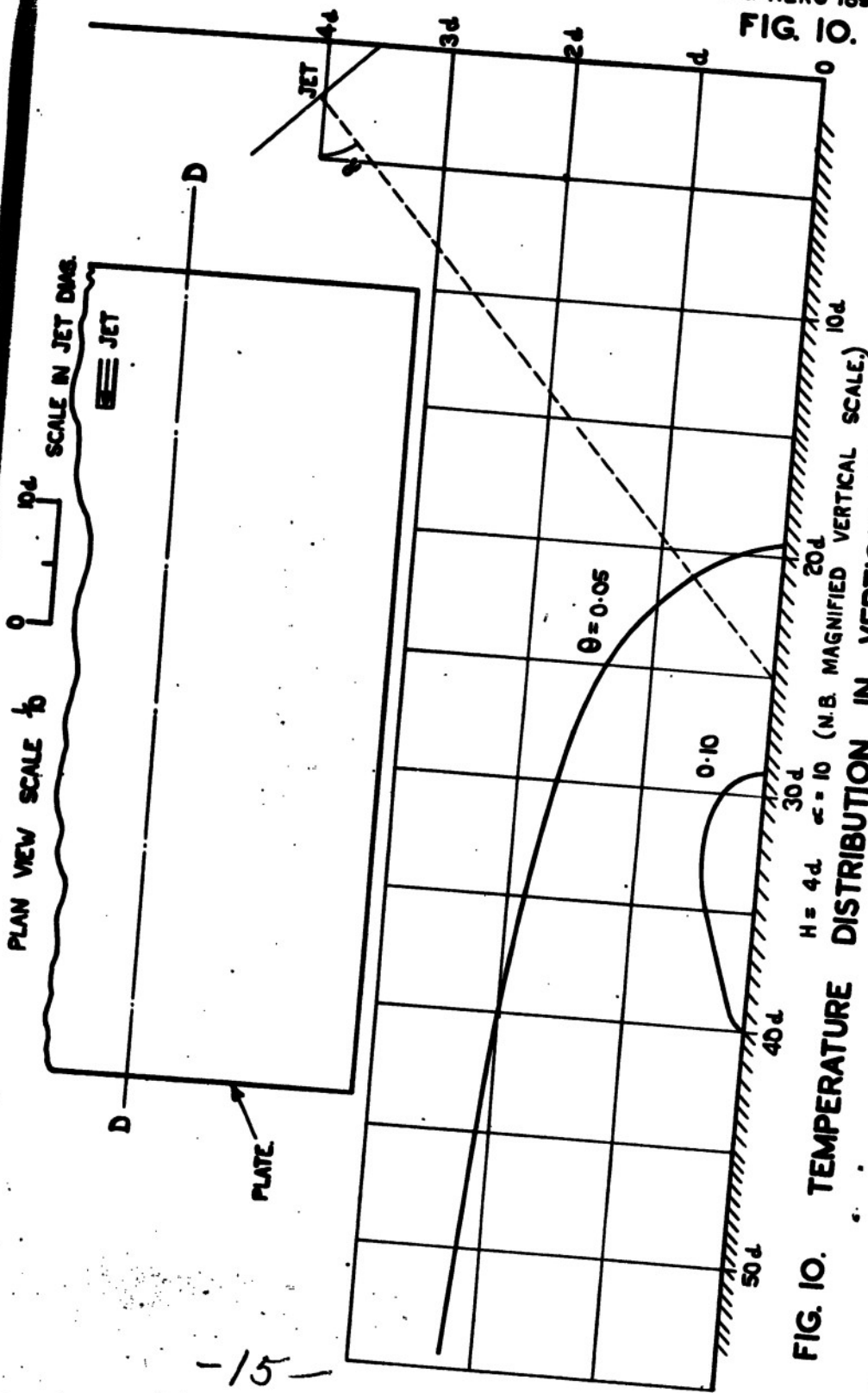


FIG. 10. TEMPERATURE DISTRIBUTION IN VERTICAL PLANE THRO' D-D.

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**AUTHOR(S)** : Worrall, A. S.; Lawlor, E. F.

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